



RESEARCH DEPARTMENT

Television Receivers Operating from Non-Synchronous Power Supplies

Report No. T.047

Serial No. 1954/24

**THE BRITISH BROADCASTING CORPORATION
ENGINEERING DIVISION**

RESEARCH DEPARTMENT

TELEVISION RECEIVERS OPERATING
FROM NON-SYNCHRONOUS POWER SUPPLIES

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SUMMARY

The tests described in this report were undertaken in order to determine the subjective effects of operating a television service without the normal mains lock by which the frame frequency of a television system is related to the frequency of the power supply.

The two major picture disturbances may be termed 'raster wobble' and intensity variation.

In these tests all the observers exhibited a considerably higher perception of deflection-modulation or raster wobble than of intensity-variation.

Data are displayed graphically, showing the probable opinions to be expected when receivers are viewed whilst fed with an a.c. power supply of frequency differing from the frame frequency of the transmission.

The results indicate that if the maximum mains-frequency excursion of the B.E.A. electricity supply does not exceed 0.2 c/s the modulation due to mains-supply frequency difference is likely to be tolerated by the majority of viewers.

1. INTRODUCTION.

It may be desirable from considerations outside the scope of this report to base the frame frequency of a television system on, say, an absolute frequency of 50 c/s, as opposed to the present practice of locking it to the mains supply. It is therefore desirable to ascertain what visual effects will be manifest on a receiver which is energised from a power supply, the frequency of which differs from 50 c/s.

Comparatively little work has been undertaken in the past to investigate the subjective effect of such conditions, as locking to the grid-system became a sine qua non since the earliest picture transmissions. There are two main undesirable manifestations of the a.c. supply on a received picture:

(a) The geometry of the picture is disturbed, principally by the H.T. line ripple modulating the time-base circuits, and induced fields embracing the cathode-ray tube causing deflection of the beam itself. In this report the sum of these effects is termed

'raster wobble'.

(b) An intensity modulation of the scanning spot over the period of an a.c. cycle, principally due to hum entering the video circuits feeding the tube modulator and to relatively poor decoupling of the brightness controls.

These preliminary tests were conducted in order to ascertain the subjective effects of these two disturbances only. No attempt has been made to analyse the relative contributions of the several causes; nor indeed have measurements been made of the absolute values of the disturbances themselves under the test conditions.

2. METHOD.

An initial experiment indicated that the frequency differences suitable for the tests could be limited to those below one cycle per second. At greater frequency differences all observers were of the opinion that the picture was unacceptable. The test difference frequencies were therefore arbitrarily chosen to be $1/16$, $1/8$, $1/4$, $1/2$ and 1.0 c/s. A short test-run revealed that it would be desirable to have extra data between the first two figures, and $1/12$ c/s was then included.

Seven receivers were used and these were supplied with a modulated r.f. signal from a common distribution system which in turn was fed from a battery-operated r.f. modulator. The picture signal input to the modulator was obtained from a high-quality and virtually hum-free source. To limit the degrees of freedom and to provide a controlled series of tests, a stationary picture of Test Card C was used throughout. Every care was taken to set up and align the receivers visually before the tests commenced. The power for the transmission channel and distribution network was supplied from the grid-system, whilst all the receivers were powered by a voltage-stabilised variable-frequency motor-alternator set. The frequency difference between these two sources was monitored on an oscilloscope against timing pulses. It was previously found possible by continuous monitoring to hold the frequency difference to $1/20$ c/s for the period of each test frequency.

Six different makes of receiver were used for observations; three of these were about two and a half years old, two others somewhat more than one year old, and two were current models. The smallest screen was 12 in. and the largest was 17 in. diameter, the receivers being arranged in an arc around the viewers.

Eighteen observers were readily obtainable; they varied from television engineers to laymen "homeviewers". They were tested in groups, placed at a typical viewing distance from the arc of screens.

Observers were asked to write down one of four symbols:

- N = Not perceptible
- J = Just perceptible
- J+ = Quite perceptible but tolerable
- A = Annoying.

The seven sets were displayed simultaneously and the observers recorded their opinions at each test frequency difference, the frequencies being described by code letters. The observers' opinions were entered under two columns labelled 'Raster Wobble' and 'Intensity Variation' respectively.

The test-runs were taken from low to high frequency difference.

3. RESULTS.

The results showed remarkably few anomalies, but the lay observers failed to perceive any disturbance at frequency differences less than $\frac{1}{8}$ c/s; at higher frequency differences there was good agreement when the picture disturbance became annoying.

Throughout the tests, all observers found the raster wobble much more evident than the intensity modulation. In the accompanying figures, observers have been classed as "least critical", "average" and "most critical", and the receivers have been shown as a percentage, e.g. an effect noted on all seven receivers is given as "100% receivers".

In all cases "average" indicates the arithmetic mean of the total results obtained at the test frequency difference in question.

The terms "least critical" and "most critical" applied to observers are self-explanatory but it should be noted that, for example, the least critical observer in one test-run was not necessarily the least critical observer shown in the next test-run at a new frequency difference.

All the results have been plotted on log/linear paper where the log-scale abscissae show the frequency difference between the power supply feeding the transmission equipment and the power supply of the receivers. On all figures the frequency difference of 0.2 c/s is indicated.

Figures 1 to 6 inclusive have ordinates calibrated in "percentage of receivers" on which the effect stated on the figure was noted.

Figures 1 and 2 show the least critical observers' entries for raster wobble and intensity variation respectively.

Figures 3 and 4 show similarly the average of all observers' entries.

Figures 5 and 6 show the most critical observers' entries for the two effects.

On each of these six figures, three curves show the boundaries between the levels of perception.

From Figure 1 it can be seen that the least critical observer did not perceive any disturbance at a frequency difference less than $\frac{1}{8}$ c/s. At $\frac{1}{2}$ c/s, for example, only 15% of the receivers were annoying, whilst 42% were just perceptible and 43% not perceptible; the sum of these percentages totalling 100.

The average observer of raster wobble (Figure 3) found at a frequency difference of $1/4$ c/s, 21% of receivers annoying, 8% tolerable, 46% just perceptible, and observed no raster wobble on the remaining 25%.

From Figure 5 it may be seen that at $1/8$ c/s the most critical observer found 20% of the receivers annoying, 20% tolerable and another 60% perceptible. At $1/2$ c/s frequency difference this observer found 80% of receivers annoying with 3% tolerable and 17% just perceptible.

It may be noted that the least critical observer did not distinguish tolerable from annoying in the case of either raster wobble or intensity modulation. The average observer, however, was able to distinguish between these two criteria, whilst the most critical observer showed a not inconsiderable range over which he considered the phenomena to be tolerable.

Neither the age of the viewers nor the age of the receivers had any discernible effect upon the results; the two "best" receivers were: one current model and one nearly eighteen months old. The two "worst" receivers were: one current model and one nearly three years old.

4. CONCLUSIONS.

The results indicate that if the maximum difference between the B.E.A. electricity supply frequency and that of the frame synchronising waveform of an unlocked television system is 0.2 c/s, the effect of intensity modulation will be tolerable to all classes of viewers. Raster wobble, however, will become annoying on 12% of receivers operated by average viewers, whilst the most critical viewers will be annoyed by 47% of receivers at present in service. These conclusions are based on tests conducted with a small number of commercial receivers and the percentages quoted above can only be taken as being indicative of the true situation.

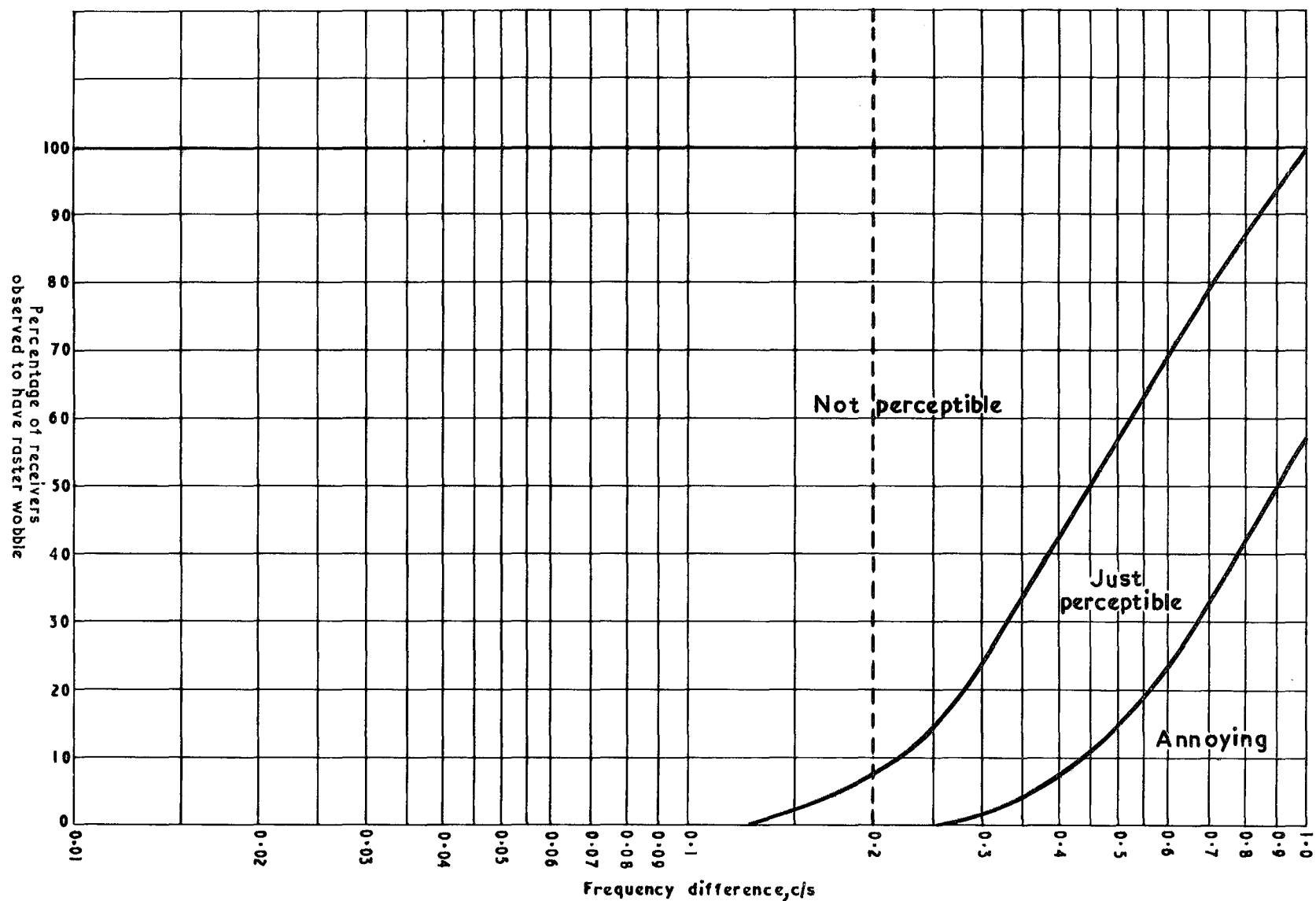


Fig.1

Least critical observer; raster wobble. (Test card "C")
(No "tolerable" entries.)

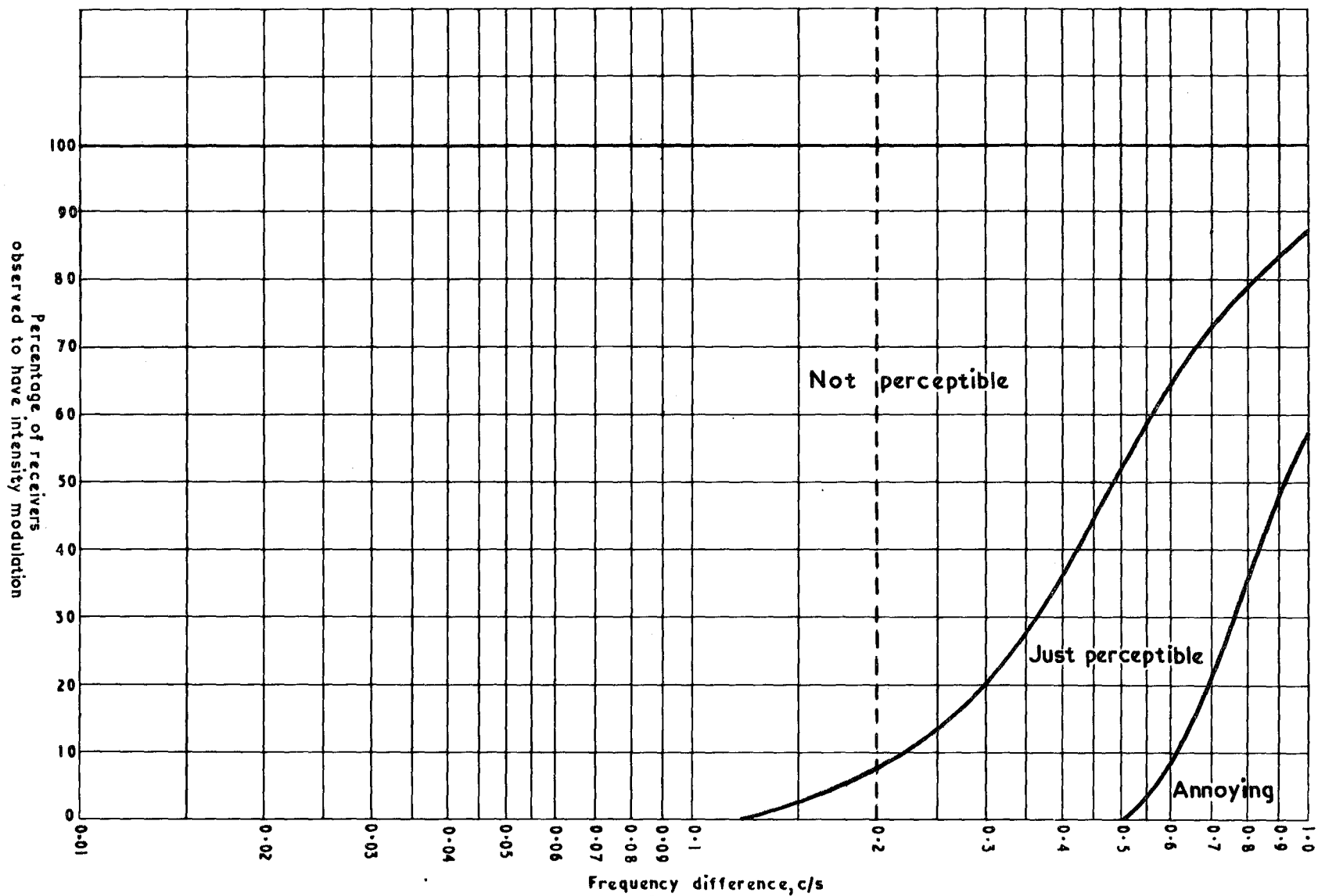


Fig. 2

Least critical observer; intensity modulation. (Test card "C")
(No "tolerable" entries.)

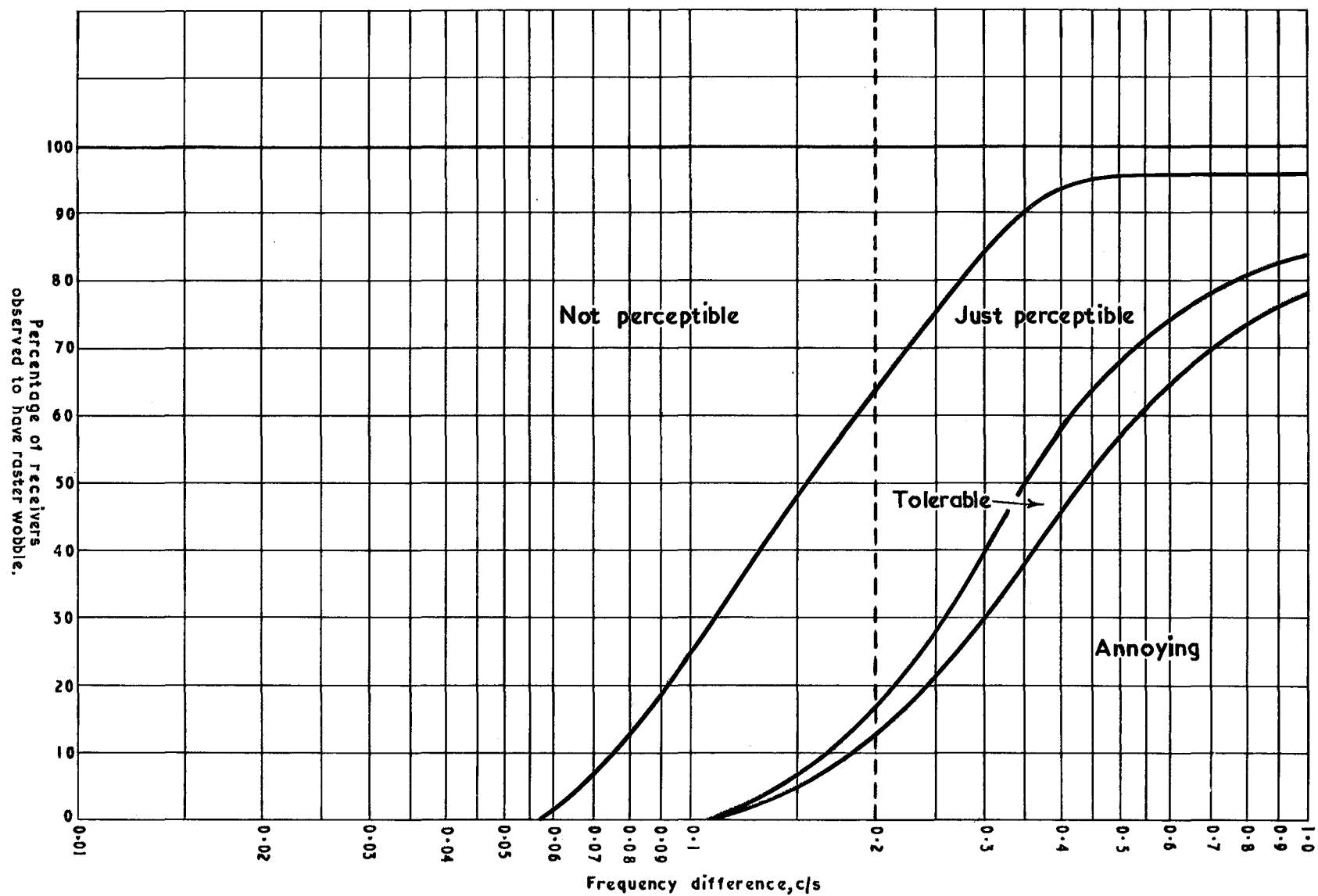


Fig.3

Average observer; raster wobble. (Test card "C")

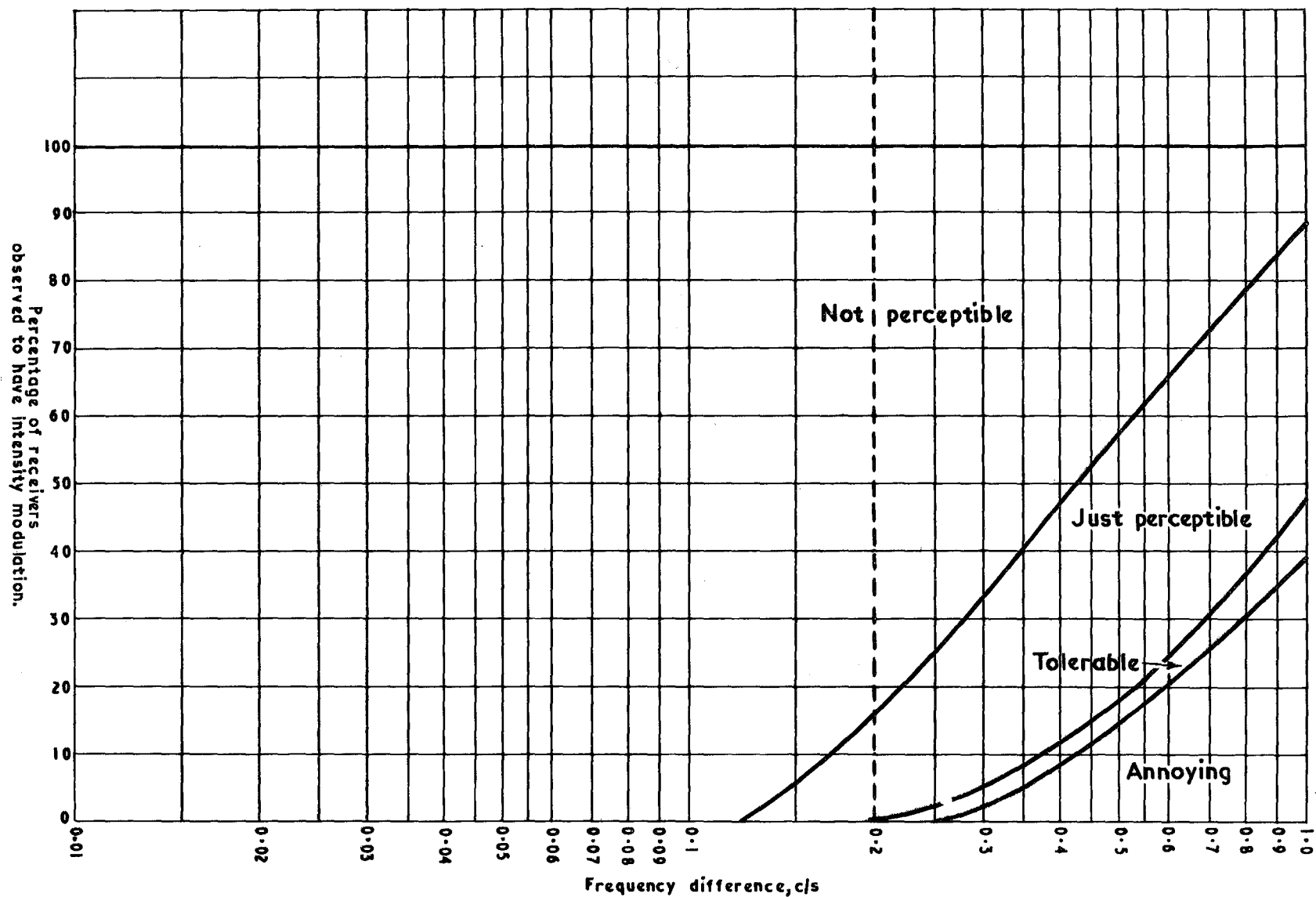


Fig. 4

Average observer; intensity modulation. (Test card "C")

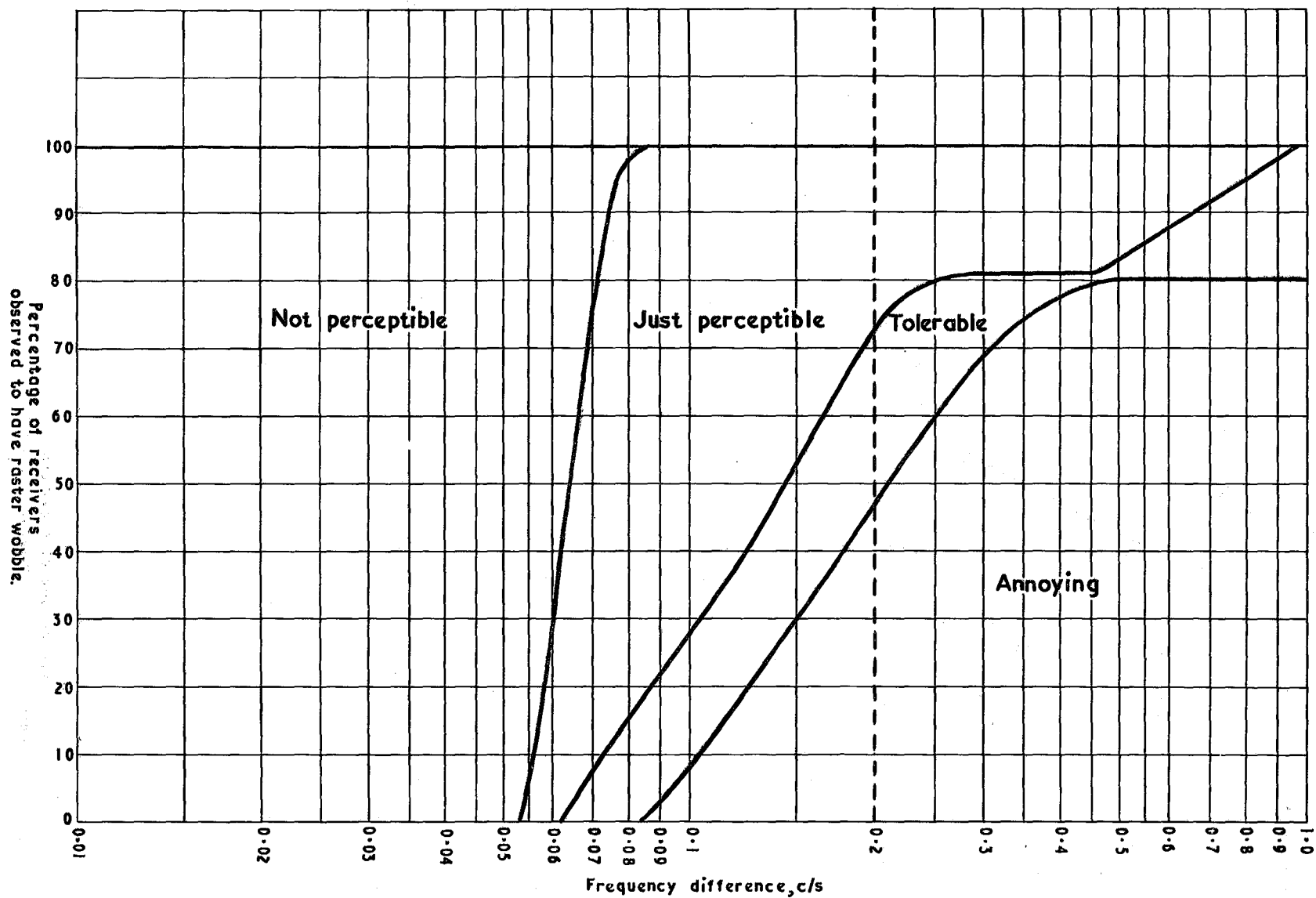


Fig. 5

Most critical observer; raster wobble. (Test card "C")

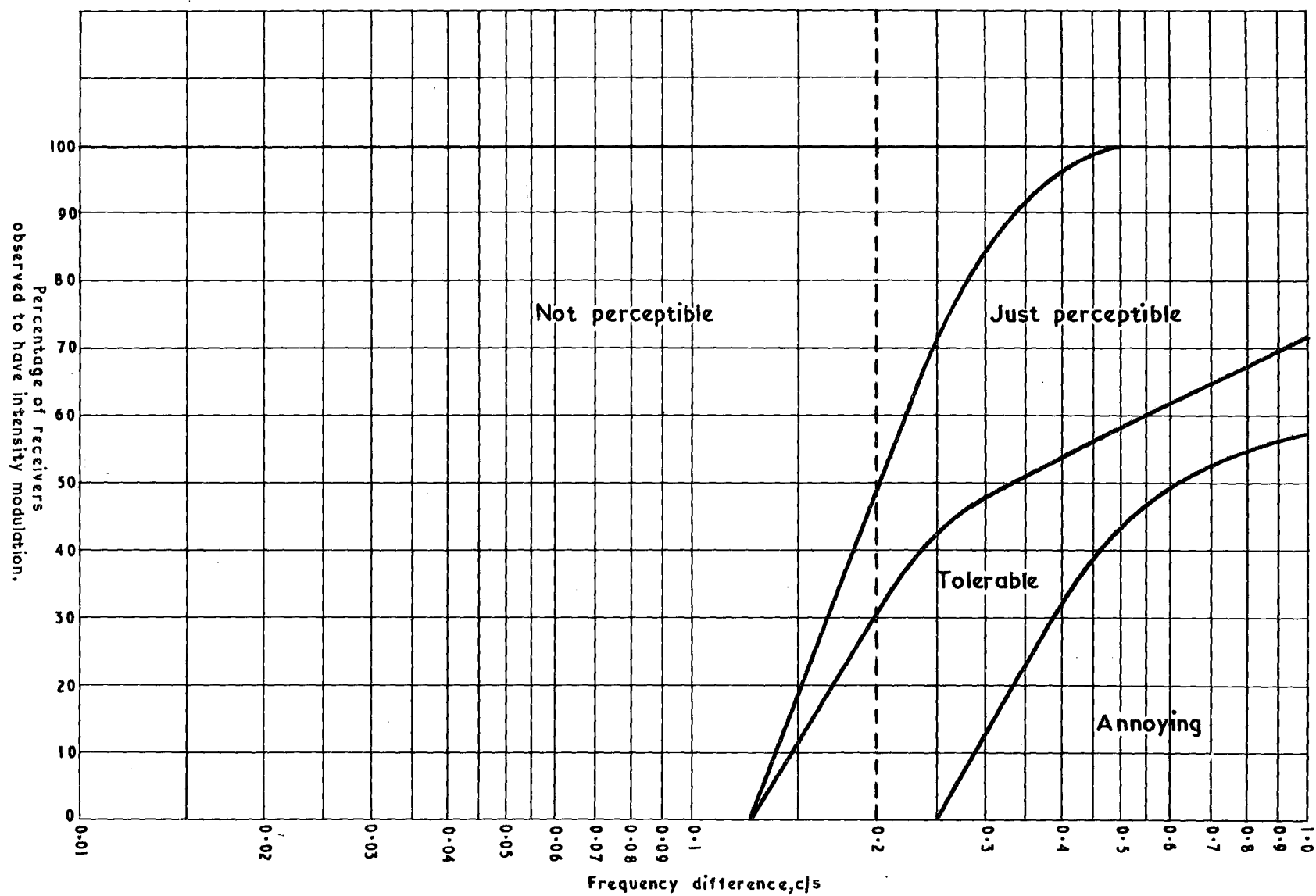


Fig. 6
Most critical observer; intensity modulation. (Test card "C")